2013 Project of the Year

Repair and Preventative Maintenance of the East Monroe Street Parking Garage

Chicago, IL

Submitted by Walsh Construction Company

Existing drive lane of the parking garage prior to repair

Existing ceiling of the lower level prior to repair

Existing conditions on the north wall prior to repair

The East Monroe Street Parking Garage was originally constructed in 1974. It is a three-level facility with two underground parking levels that accommodate 3850 vehicles. The facility includes about 1,470,000 ft^2 (136,570 m^2) of garage space. Along with three other related parking facilities, they provide over 9000 parking spaces beneath Chicago's Millennium and Grant Parks in downtown Chicago and adjacent to Lake Michigan.

The East Monroe Street Parking Garage has a 753 x 1179 ft (230 x 359 m) footprint. The top (roof lid) level supports Maggie Daley Park. This 20+ acre (80,940 m^2) park is currently under renovation and, when completed in 2015, will feature multi-sensory landscaping, an ice skating ribbon, rock climbing sculptures, play gardens, and multiple event spaces.

CAUSES OF DETERIORATION

The parking garage has been in operation for almost 4 decades. Exterior and interior structural elements were severely deteriorated from seasonal and environmental exposure. This exposure caused corrosion damage to the concrete walls, columns, slabs, and ceilings. Structural condition surveys discovered that much of the concrete had extensive deterioration, delamination, and spalling on the surfaces. The majority of the deterioration was due to corrosion of embedded top reinforcing steel and a chloride-contaminated environment.

The structural slab consists of 9 in. (229 mm) of conventionally reinforced concrete. There were a variety of traffic-bearing waterproofing systems of different vintages on the top floor surfaces. All existing top reinforcing steel was deteriorated and in need of replacement.

Cracks in the concrete leaked severely, exposing portions of the structure to both topside and underside deterioration.

INSPECTION/EVALUATION METHODS AND TEST RESULTS

Preliminary recommendations included complete slab replacement in all areas of the structure. Indeed, extensive, full-depth deterioration was noted in primary areas such as the entrance and exit lanes and primary drive lanes and ramps. However, the extent of the deterioration was visually less in parking module areas. Additional testing (chloride and corrosion half-cell potentials) at the underside of many slab areas revealed little or no chloride contamination or corrosion potentials. Accordingly, the engineering firm designed a unique approach that incorporated hydromilling to remove the chloride-contaminated portions of the slabs. A combination of full-depth repairs and a partial-depth overlay was adapted as a cost-effective, long-term repair approach while updating the structure to meet the current requirements of the Chicago Building Code.

A new, (dry) sprinkler fire suppression system and fire doors were installed. These new features provided an added benefit in that it permitted the removal of every other fire separation wall to create new open areas of 80,000 ft^2 (7432 m^2) versus the original 40,000 ft^2 (3716 m^2), enhancing the parking experience from a site visibility and security standpoint.

SITE PREPARATION

The original plan called for the underground garage to remain partially open during the restoration but due to the fast-track nature of the project, the logistical difficulties in decommissioning existing life safety systems in an underground structure and bringing all new life safety systems online in reopened areas, a different approach was pursued. It was decided that the facility would be closed and the work would proceed in the shortest possible time. The goal was to complete the project in approximately half the original allotted time. Before work could begin, all vehicles were cleared from the facility. Additional site preparation measures included creating a detailed logistics plan, which was a challenge because crews needed to share an entrance with an adjacent garage that remained open at all times. All pumping equipment and trucks needed to safely stay out of the way of live traffic.

DEMOLITION METHOD

Hydrodemolition (milling) was chosen as the most efficient approach. The combination of underground work and hydrodemolition posed distinct challenges not typically present in most projects. The roaring noise coming from the specialized equipment was over 100 decibels, creating a communication challenge. Furthermore, 36,000 psi (248 MPa) of water pressure was used to selectively remove portions or, in some areas, all of the slab surface. Hand chipping was performed around columns and drop head using 15 lb (6.8 kg) air hammers.

Up to five hydrodemolition machines working at once

Lower-level shoring and reshoring due to unforeseen conditions

The use of hydrodemolition equipment required the enforcement of special safety precautions. Face shields, safety glasses, and walkie-talkies kept the crews safe and in constant communication.

Since the garage consists of two parking levels (upper and lower levels), fall hazards were prevalent on the upper levels due to holes that were a result of blow-throughs (that is, full depth removal). Nets were erected at areas adjacent to hydrodemolition work to separate and protect workers.

SURFACE PREPARATION

After the completion of the hydrodemolition, reinforcing steel was inspected to meet the criteria in the specifications. Any bar that did not meet

North wall demolition and prep for receiving concrete

Prepour inspection of a concrete slab that includes full-depth repairs

Crews placing concrete

specification was removed. To ensure proper bonding, workers sandblasted partial-depth areas. The surface was then cleaned by blowing and vacuuming to eliminate any foreign matter that might interfere with adhesion to the existing slab.

APPLICATION METHOD SELECTION

Each full-depth area was framed, and new epoxy-coated steel was installed in the top mat of reinforcing as well as in the bottom mat in full-depth areas. Concrete was placed from the top surface through air shafts by truck pumps. A pipe system was brought in to be used once underground to transport the concrete to the placement area. From that point, the slabs were water cured according to the specifications.

To ensure the longevity of the new structure, low water-cement ratio concrete, epoxy coated steel, and a polyester-reinforced, hot rubberized waterproofing membrane was placed over the water-cured slabs. This high-performance waterproofing system was then protected by a minimum 1.5 in. (38 mm) thick, asphalt-paved driving surface. The new slab surfaces were shotblasted clean to ensure proper bond of the membrane to the slab.

REPAIR PROCESS EXECUTION

Debris from the demolition had to be moved to place the shoring for the frame work. The surfaces of partial-depth areas were sandblasted and cleaned.

The next step of the process was saturating the surface with water, covering it with wet burlap, and then covering it with plastic to retain the moisture for a minimum of 24 hours. The plastic and burlap were peeled back one bay ahead of the pour on the day of placement. The slabs were placed in 14 ft (4.3 m) bays at an average of 18,000 ft^2 (1672 m^2) per placement. The surface was then wet-cured using the burlap and plastic from the saturated-surface dry (SSD).

The north exterior wall showed severe deterioration from years of exposure to moisture and deicing salts that leaked through a failed expansion joint from the public sidewalk area above. The delaminated concrete was removed from the wall surface, then sandblasted and inspected, and new reinforcement was placed. The wall needed to be framed and saturated until placement. The concrete was placed mainly by truck, pumping self-consolidating concrete along with hand-mixed material into a framed cavity. All the work was done off of swing stages.

UNFORESEEN CONDITIONS FOUND

Unexpected and unforeseen conditions that presented unique challenges to the team included reshoring column drop heads due to the extensive amount of full-depth repairs, which compromised

the drop head connection to the existing floor. A complete redesign of fire suppression systems was necessary based on the City of Chicago requirement of a two-sourced water supply for the dry sprinkler system, which involved direction boring to tap into the waterline from Monroe Street.

Another challenge unique to the East Monroe Street Parking Garage project was its ventilation, lighting, communication, and egress based on its underground location. The accelerated project schedule also created a unique challenge. The schedule called for completion of the project in 455 days, so working through the winter months was a must. Additionally, working in the heart of the City of Chicago presented many logistical challenges. There was a time period during the winter months in which the crews worked 24 hours a day due to cold and freezing temperatures, which made job conditions extremely difficult to manage. Controlling the water usage and collection while allowing proper drainage during the freezing temperatures was a challenge.

Other significant unforeseen conditions included:

- The removal of micro silica overlay on the existing slab entrance;
- The amount of unreinforced and under-reinforced drop heads; and
- The total area repaired on the north wall increased by thousands of square feet (square meters).

SPECIAL FEATURES

The repair and preventative maintenance at the East Monroe Street Parking Garage revitalized an essential commuter hub in downtown Chicago.

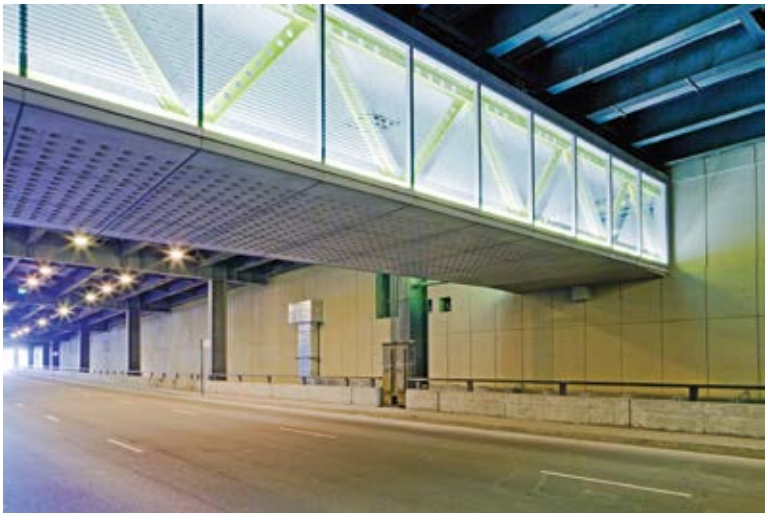
This project was extremely unique because it was entirely underground. Ventilation, temporary lighting, wireless phone usage, and ingress/egress to the site are typically not a cause for concern on most projects, but being underground is a different scenario. Maintaining proper ventilation and lighting were major concerns. Supply and exhaust fans surrounding the garage were monitored daily to ensure they were functioning properly, and carbon monoxide levels were monitored regularly. Without proper ventilation, none of the machines and equipment could be used. The main culprits, of course, were the hydrodemolition machines. Not only did they exhaust a large amount of carbon monoxide, they also emitted a lot of heat and introduced a tremendous amount of moisture into the air. When these machines were running at full capacity, a mist formed around them causing humidity and visibility concerns in the area—and the water spray guns only made things worse. Blowers and fans were situated at these areas to combat these hazards. An icebox was provided to battle heat exhaustion among the workers. Also, additional landline phones were

Placing of concrete at the north wall

Waterproofing and asphalt process on the upper level

Waterproofing of the parking garage and repaired ceiling prior to painting

Finished drive lane of the parking garage



North wall finished

Finished parking garage

installed at various locations within the garage. All of these measures ensured a safe and successful project.

WHAT SETS THIS PROJECT APART?

- Full-depth replacement: 234,000 ft^2 (21,740 m^2);
- New concrete overlay replacement: 800,000 ft^2 (74,322 m^2);
- Overhead repairs: 5000 ft^2 (465 m^2);
- Vertical repairs to the north wall: 13,000 ft^2 (1208 m^2);
- 15,000 yd^3 (11,470 m^3) of concrete;
- 1,432,000 lb (649,544 kg) of steel;
- The East Monroe Garage is the largest of the four garage parking systems that make up the largest underground parking system in the world;
- Unique demolition and concrete repair to a below ground structure;
- Restoration to a facility, incorporating long-term solutions that will last the test of time;
- Repair of corrosion and moisture damage to an entire concrete structure and exterior vertical walls;
- Working under unique and hazardous conditions, on a scale that has never been seen on an underground parking structure;
- Unique solutions to unexpected and unforeseen conditions;
- Expedited work schedule that was completed in a short amount of time;
- Replacement of concrete at the parking entrance where there was live traffic;
- The volume of water and debris from lower-level demolition completely removed; and
- As part of the park renovation project over the garage, a complete membrane tear off and re-waterproofing of the top level was performed.

East Monroe Street Parking Garage

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AMI Group, LLC
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REPAIR CONTRACTOR
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